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REVİEW

The Physical and Mental Health Benefits of Lifestyle Sports for Disabled People: A Scoping Review

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Abstract
There is growing evidence to suggest the physical and mental health benefits of lifestyle sports (LS) in disabled people. However, disabled people are less likely to participate in sports than those without disabilities and the evidence base is sporadic. We conducted a scoping review to explore the range and quality of this evidence base. **Methods:** Eligible studies consisted of participants participating in LS with a physical, intellectual, mental or sensory disability and included both adults and children. Descriptive, thematic and quality assessment techniques were used to provide a comprehensive summary of all evidence. **Results:** We identified 57 studies, across seven different sports, with numerous physical and mental health benefits to disabled people, including improved strength, fitness and balance as well as confidence, self-esteem and overall psychological wellbeing. Key emergent themes were that participation in LS promoted the development of social skills and building of community. **Conclusions:** Our scoping review was the first to explore this field of research, revealing a unanimously positive association between lifestyle sports and physical and mental health. Future research could focus on understanding the relationship and mechanisms between the sport, being in nature, or participating as part of a group that creates health benefits; and identifying appropriate duration, intensity and quantity of participation needed for long-term improvements.

Keywords
Lifestyle Sports', Disability, Mental Health, Physical Health, Social

INTRODUCTION

Participating in regular physical activity (PA) is an established protective factor for the prevention and treatment of noncommunicable diseases, including heart disease, stroke, diabetes and breast and colon cancer (World Health Organisation, 2020). Benefits range from improving cardiorespiratory fitness and muscular strength (Appelqvist-Schmidlechner et al., 2020), to reducing obesity (Henriksson et al., 2020). PA has consistently been shown to reduce levels of anxiety and depression, help people develop relationships and a sense of community, and improve general wellbeing and quality of life (Public Health England, 2018). Despite these health benefits, 1 in 4 adults globally does not meet the recommended public health guidelines for PA (WHO, 2020). This physical inactivity causes approximately 3.2 million deaths worldwide each year and accounts for an estimated $53.8 billion in worldwide healthcare costs (Katzmarzyk et al., 2021).

Disability is a global health and human rights issue (United Nations, 2006) with an estimated 1.5 billion people with disabilities

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worldwide (WHO, 2011). There are various definitions of disability and ways of identifying as disabled exist across the globe. Some use the term 'disabled people', whereas others prefer 'people with disabilities' or 'people with an impairment'. However, for the purposes of this paper we will use the term 'disabled people' aligning more with a social model of disability whilst representing a more inclusive language (GOV.UK, 2016).

No data exists on what patterns or types of PA are performed by active disabled adults in the UK as they are not included in UK national health surveillance surveys. According to the latest Public Health England data (2018), disabled people are twice as likely to be inactive when compared to non-disabled people with 43% of all disabled adults doing less than 30 minutes of PA a week (PHE, 2018). Disabled people are also less likely to participate in sports than those without disabilities (Jaarsma et al., 2014), despite research showing that engaging in PA poses no increased risk of harm to disabled people (Smith & Wightman, 2019). This lack of participation may be due to several physical, environmental and social barriers facing disabled people, or may simply reflect the global decline in mainstream team sports participation (Hajkowicz et al., 2013). Therefore, it could be helpful to explore promoting the non "typical sports". These activities might be more accessible, of more interest and could provide disabled people with more chance to improve their physical and mental health – lifestyle sports.

This new class of sport has emerged in the last few decades, variously called extreme, adventure, action, and lifestyle sports (Brymer et al., 2020). Typically occurring on water, land and in the air these sports are not governed by the same rules and regulations in mainstream sports. They often involve being in a natural environment and away from the manicured surroundings of traditional sports. Sport England (2021) states that 3.2 million adults participated in adventure sports between November 2019 to November 2020 and for children and young people, active play and informal activity is now the most common type of activity above team sports, running, walking and swimming.

Whatever type or extremity of lifestyle sports' undertaken, all offer a new and alternative way of being active and these lifestyle sports' are now seen as one of the important 'mega trends' of the twenty-first century sport-scape which contrasts with the decline of most team sports (Hajkowicz et al., 2013). Furthermore, these sports have started to be understood for their ability to act as therapeutic interventions for addictions and substance abuse. Roderique-Davies et al. (2018) found that the thrill of rock climbing acted as a replacement for drugs, while Roberts et al. (2018) concluded mountain biking could become a coping strategy for mental health issues.

In 2019 the UK Chief Medical Officer published the first guidelines on PA and sedentary behaviour that acknowledged people living with disability (Department of Health and Social Care, 2019). This was followed in 2020 by the World Health Organisation (Carty et al., 2021). However, in order to achieve these goals as well as meet the PA guidelines, it is important to look at new, modern and inclusive sports as a means to encourage participation for disabled people.

There is growing evidence to suggest the mental and physical health benefits of lifestyle sports for disabled people, but, to date, the research is sporadic and covers a range of methodologies. Our scoping review maps the literature on lifestyle sports and health, exploring how these sports can benefit the physical and mental health of disabled people. By comprehensively reviewing all available literature, identifying gaps in evidence and proposing future areas of research, this paper aims to map the evidence-base that could help to influence disabled people's sports and PA choices and impact upon future policy.

MATERIALS AND METHODS

The methodological framework for this scoping review was conducted using the established five-stage process by Arksey and O'Malley (2005) incorporating adaptations suggested by Daudt et al. (2013). It followed the Preferred Reporting Items for Systematic Reviews and Meta-analyses extension for Scoping Reviews (PRISMA-ScR) guidelines (Tricco et al., 2018).

The following outlines our approach to each stage.

Stage 1: Identifying the research question

The research question was designed according to the following frameworks: Feasible, Interesting, Novel, Ethical and Relevant (FINER) (Farrugia et al., 2010). Alongside this, the PCC

mnemonic (population, concept and context) was used in order to help refine a clear and meaningful title (Peters et al., 2015). A broad research question was set in order to capture all of the study population, sports and subsequent benefits:
"What are the physical and mental health benefits of lifestyle sports for disabled people?"

Stage 2: Identifying relevant studies

The list of lifestyle sports is extensive and so initially this review narrowed the search down to the most prominent sports (Figure 1). Our pilot searches identified that many modern lifestyle sports, such as kitesurfing, skydiving and freediving, do not have any research on their health benefits for disabled people. We expanded to include all types of lifestyle sports in order to broaden the scoping net and ensure fair coverage.

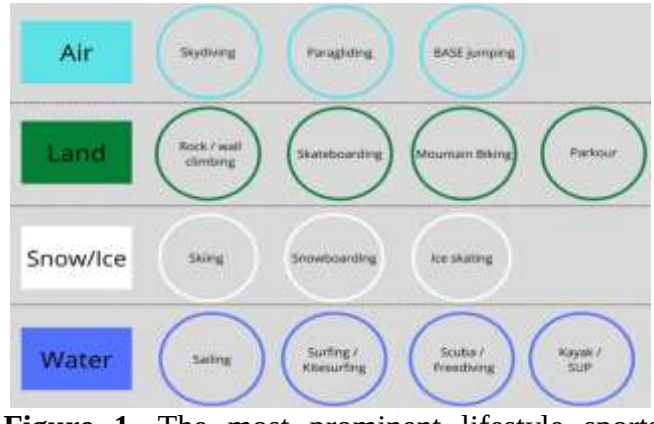

Figure 1. The most prominent lifestyle sports (adapted from Cohen et al., 2018; Wheaton, 2013)

Potential articles were screened against the following inclusion criteria:

- Research articles conducted in English but not limited by geographical location or setting.
- All types of lifestyle sports based on inclusion definitions set by Wheaton. (2013).
- Any form of disability including mental health disorders.
- All age groups and all gender identities.
- Research that considers the physical and/or mental health benefits of these sports for disabled people including specialist therapy-based interventions.
- Sources of information, including primary research studies, reviews, systematic reviews, scoping reviews, meta-analyses, guidelines, as well as grey literature to include unpublished and ongoing trials annual reports, dissertations and conference proceedings.

Databases

We searched four databases, PubMed, Ovid, Scopus, and Web of Science An earliest record/open date limit was set, and searches included doctoral and master's degree theses to ensure the greatest scope of available literature. The search end date was June 2021. In addition to this, a hand-search was conducted using the references list of the most relevant research papers and further cross referencing was conducted upon reviewing chosen research papers' 'Introduction' and 'Discussion' sections to ensure no papers were missed.

Search terms

Key terms were selected to locate relevant studies. To keep the search scope as broad as possible the term "disability" was used as the main search term in order to include all aspects of disability. Once this search was done, it was combined initially with broad sports terms such as "lifestyle sports" OR "extreme sports" OR "action sports" OR "adventure sports", all of which encapsulate the meaning of lifestyle sports. However, this pilot search process initiated limited results and so more refined lifestyle sports terms were used such as: "surfing", "skiing", "rock climbing" etc. These sports were then combined individually with the term "disability" and entered into the databases with an AND. For example, "surfing" AND "disability". As the process evolved the search terms were further refined, using "disability" AND "the chosen sport" combined with "physical health" and "mental health".

Stage 3: Study selection

All research titles were screened for relevance based upon the research question of the scoping review. Papers were discarded if any duplicates were found and abstracts were then evaluated against the strict eligibility criteria. Other lifestyle sports not initially considered such as 'Ice Skating' and 'Kayaking / Stand Up Paddle (SUP)', were included to enhance the breadth of the research findings.

Stage 4: Charting the data

The fourth stage of the scoping review process was to organise all of the data from the selected papers. A data extraction table, using Microsoft Excel version 16, was utilised for this stage. A priori categories were charted as were

emergent themes. The collected data points were author(s), sports type, disability type, study population, physical health benefits, mental health benefits, reduction in symptoms of disability, injuries, costs, barriers to participation, longevity of benefits, impact on family members / caregivers, emergent themes, areas for future research, aims / purpose, methods, outcomes, key findings. See Table 1for an abbreviated table, illustrating study characteristics and key findings related to the research question.

Several outcomes were identified as being associated with physical and mental health and thus, to ensure consistency with the studies found, data were extracted to reflect what the authors of those studies identified as important outcomes. These improved outcomes including physical, mental and social health were reported in this review using the same terminology.

Methodological quality appraisal

Although scoping reviews do not require a quality assessment of included papers, as the aim of a scoping review is to map all the research comprehensively, this review attempted to critically appraise all included research in terms of their methodological quality and generalisability (Peters et al., 2015). Quality of evidence including overall confidence in results was graded (high, moderate, low) by the reviewer based upon design, relevance, validity of measurements and conduct of study (Glasziou et al., 2004). Generalisability was graded (high, moderate and low) by population size, population type and setting characteristics (Burchett et al., 2020).

Stage 5: Collating, summarising and reporting the results

The final stage was to collate all of the relevant findings detailed in the data extraction table and then summarise and present the most pertinent information based on the relevance to the research question.

1. A descriptive analysis, mapping the data, on the country of origin, year of publication, distribution of sports, study population, type of disability and type of study.
2. A thematic summary identifying the key themes that are throughout the studies and their relevance to the research question.

RESULTS

Descriptive analysis

A PRISMA scoping review flow diagram (Figure 2) details the results from the search and subsequent study selection process. In total, 16,046 studies were identified across all five databases. After duplicates were excluded, alongside any papers that did not meet inclusion criteria, 68 studies remained. In addition to this, 10 papers were hand-picked through the review process leaving a total of 78 studies for full text screening. In the process of full text review, 15 studies were excluded due to being 'pay per view' as well as six studies removed for not meeting our explicit eligibility criteria. Overall, the scoping review identified 57 eligible studies that are used in the analysis.

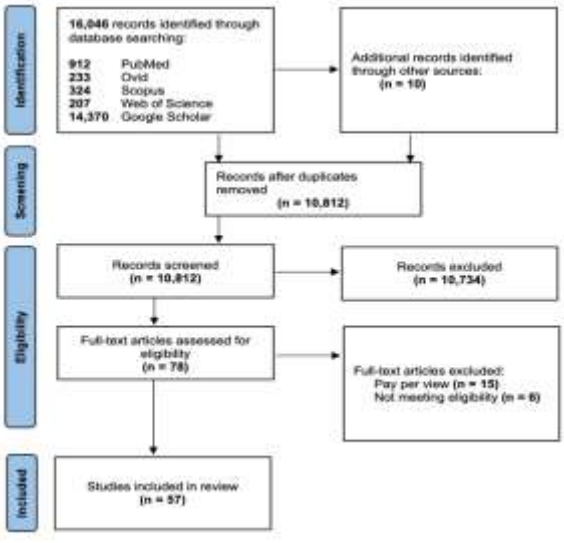

Figure 2. Scoping review flowchart

Overview of included studies

Fifty-seven articles reported studies from 21 different countries. We identified seven different lifestyle sports. Physical disability was the most common type of disability (18 studies) with spinal cord injury (7 studies) being the most prevalent in that group. This was followed closely by the 'mixed disabilities' grouping with 16 studies in total, of which 11 were multiple disabilities. There were 11 studies that included participants with intellectual and learning disabilities and 11 studies on those with mental disorders, with 1 study focussing on those with sensory impairments. See ancillary material for detail.

Quality and designs of studies

Overall, the majority of studies had moderate quality (34/57 studies; 59%) and low generalisability (33/57 studies; 68%). Four studies were deemed of high quality all of which were RCTs, two in rock climbing (Velikonja et al., 2010; Stelzer et al., 2018) and two in sailing (Carta et al., 2014; Sancassiani et al., 2017). There were seven studies that were assessed to have high generalisability, five in surfing (Clapham et al., 2021; Devine-Wright & Godfrey, 2020; Glassman et al., 2021; Van Ewijk et al., 2020; Walter et al., 2019), one for scuba diving (Henrykowska et al., 2021) and one for sailing (Broadbent & Swalwell, 2018). See Appendix 1 for these grades alongside a breakdown of the improved health outcomes.

Fifty-one studies (89.5%) were primary research with quantitative methods being used for over half of all studies (28 studies; 53.8%). The largest proportion of study designs used were experimental (14 studies; 24.6%), cross sectional (12 studies; 21.1%) and longitudinal (10 studies; 17.5%). Surveys were the most used instrument for collecting data (66.7% of studies). There were only four randomised controlled trials conducted, highlighting a need for more research with this strong form of evidence. Of the secondary research, four were reviews, none of which were systematic reviews. No grey literature was found. Table 1 outlines the overall breakdown of all study type, methods, design and instruments used.

Table 1. Summary of key findings

	Author (Year), Country	Disability category (type)	Study population / sample size	Aims/purpose of the study	Study type, method, design, instruments	Key benefits
SURFING	Clapham et al. (2020), USA	INTELLECTUAL & LEARNING DISABILITY (multiple disabilities)	N=91, Mage 12.55, 75% male	To explore the effects of an eight-week surfing intervention on various physical fitness measures in 71 children with disabilities.	Primary, quantitative, causal comparative, surveys	Physical, mental, social and positive impact on family/caregivers
	Schmid et al. (2019), USA	MIXED (4 with Spinal Cord Injury + 2 with neurological disability)	N=6, age range = 30-64, 50% male	To assess the outcomes of a surf camp on disabled people	Primary, qualitative, case study, interviews	Physical, mental, social and positive impact on family/caregivers
	Caddick et al. (2015), UK	MENTAL DISORDER (PTSD)	N=15, age range = 27-60, 100% male	Assessing male combat veterans narratives of PTSD after a surfing intervention	Primary, Qualitative, Longitudinal, interviews	Social
	Moore et al. (2017), USA	INTELLECTUAL (Representing children of a range of disabilities from Clapham et al. (2020) study)	N=11, parents/caregivers	Parents perspectives on surf therapy for children with disabilities	Primary - qualitative- cross sectional - interviews	Physical, mental, social and positive impact on family/caregivers
	Caddick and Smith. (2017), UK	MENTAL DISORDER (PTSD)	N=15, age range = 27-60, 100% male	A narrative study of male combat veterans surfing and war trauma	Primary- qualitative- longitudinal - interviews narrative	Mental, Social
	Glassman et al. (2021), USA	MIXED (Physical and/or mental disorders - depression)	N=74, Mage = 28, 55% male	Examined the outcomes of a therapeutic surf therapy programme for active military staff including looking at gender differences in outcomes.	Primary - Quantitative - experimental - survey	Mental, social

Ewijk et al. (2020), Netherlands	INTELLECTUAL (Down syndrome, autism spectrum disorder or attention-deficit/hyperactivity disorder)	N=84, Mage = 12.5, 76% male	Investigated the effects of surfing on the Quality of life of children with developmental difficulties.	Primary - Mixed - experimental - survey	Mental, social, home-life
Devine-Wright & Godfrey (2020), UK	MIXED (Vulnerable people experiencing long term illness, disability or mental ill health)	N=324, age range = 18-21	Examined the impact of the 'wave project' surfing programme for vulnerable young people.	Primary - Mixed - Longitudinal-instruments = mixed	Mental, social, home-life
Rogers et al. (2014), USA	MENTAL DISORDER (PTSD)	N=14, 93% males	Assessed the effectiveness of surf therapy for the treatment of PTSD for combat veterans	Primary - Quantitative-Cohort-Survey	Mental
Fleischman et al. (2011),USA	PHYSICAL (Amputee)	N=1, age = 24, male	Looked at if surfing is a means of therapy for combated related poly-trauma	Primary-Qualitative-case-survey	Physical
Crawford (2016), USA	MENTAL DISORDER (PTSD)	N=14, 93% male	To determine the effect of surf therapy on combat veterans with PTSD. The focus was to determine if the therapy reduced PTSD symptoms, decreased depression and increased self-efficacy among veterans.	Primary-Quantitative-longitudinal-survey	Mental, social
Walter et al. (2019), USA	MENTAL DISORDER (PTSD, MDD)	N=74, Mage = 28, 55% male	This study examined psychological outcomes among 74 active duty service members participating in the Naval Medical Center San Diego surf therapy program.	Primary-Quantitative-longitudinal-survey	Mental
Otis et al. (2020), USA	MENTAL DISORDER (PTSD, MDD)	N=47, Mage = 29, 53% male	This study compared changes in depression/anxiety and positive affect during surf therapy sessions between active duty service members with co-morbid PTSD and MDD and those with either disorder alone.	Primary – quantitative - longitudinal - survey	Mental
Lopes et al. (2018), Portugal	MIXED (Multiple disabilities)	Children (unspecified amount)	To demonstrate how adaptive surfing can be an important tool to promote physical health and well-being, mental health and psychological well-being along with the social interaction and inclusion of persons with disabilities,	Secondary - Qualitative-case-survey	Mental, social

				regardless of their age or disability		
	Benninger et al. (2020), USA	MIXED (Multiple disabilities)	13 studies on disability - mixed ages	Scoping review of surf therapy as a form of treatment for a wide range of people.	Secondary - review	Physical, mental, social
	Armitano et al. (2015), USA	INTELLECTUAL (Multiple disabilities)	N=16, age range 6-15, 69% male	Assess the effectiveness of an 8-week surf intervention for disabled children	Primary – quantitative - experimental - survey. Pre-post test	Physical
	Van de Merwe & Yarrow. (2020), S.Africa	INTELLECTUAL (Autism spectrum)	N=45, age range = 13-17, 89% male	Assessing the impact of surfing for children with autism in South Africa	Primary -mixed - case study - survey	Mental, social, home-life
	Stuhl & Porter (2015), USA	INTELLECTUAL (Autism spectrum)	6 studies (children)	Review of surfing as a means of therapy for children with autism	Secondary - review	Physical, mental, social
	Britton et al. (2020), Ireland	INTELLECTUAL (Autism spectrum)	N=12, age range = 8-17, 40% male	To understand the Embodied and Therapeutic Experiences of Young Surfers with Autism.	Primary - qualitative - longitudinal - other	Mental, social, home-life
SCUBA DIVING	Henrykowska et al. (2021), Poland	MIXED (78% dysfunction of the musculoskeletal system - the rest with vision dysfunction and neurological disease)-	N=182, age range = 22-75, 69% men	The exploration of the potential therapeutic benefits of scuba diving for the mental and physical health of people with physical disabilities.	Primary – quantitative - cross sectional - survey	Physical, mental, social
	Morgan et al. (2018), UK	MIXED (life-changing physical or mental health injury resulting from military service)	N=15, 100% male	To explore the effectiveness of scuba diving in providing therapeutic and rehabilitative benefit to ex-service personnel who have experienced traumatic physical and/or psychological injuries resulting from combat.	Primary – quantitative - cross sectional - survey	Mental, social, home-life
	Carin-Levy & Jones, (2007), UK	PHYSICAL (2x spinal cord injury, 1x amputation)	N=3, age range = 33-53,	This project investigated the psychosocial benefits of scuba diving for individuals with acquired physical impairments	Primary- Qualitative- phenomenological -survey	Mental, social
	Stefania et al. (2019), Italy	MIXED (Down syndrome (n=14), autism, paraplegia and cognitive delay)	N=23, age range = 16-30, 70% male	Assessment of the impact of an inclusive diving program, on subjects with cognitive disability	Primary - quantitative experimental- survey	Mental

	Yarwasky & Furst (1996), USA	MIXED (3 paraplegic, 1 quadriplegic, 2 cerebral palsy, 1 amputee, 1 cognitive disability)	N=16 (8 disabled and 8 able bodied), Mage = 35	To understand the motivations and experiences of disabled people in SUBA diving.	Primary-Qualitative-cross sectional-survey	Fun and a thrill
	Naumann et al. (2021), Australia	MIXED (SCI, depression, cerebral palsy , spina bifida, quadriplegia, multiple brain trauma)	N=6 adults, age range = 24-54, 66% male	The aim of this study was to produce a descriptive overview of Immersion Therapy and explore measures used to capture physical and psychosocial experiences.	Primary -mixed-experimental case-survey	Physical, mental, social
	Blumhorst et al. (2020), USA	MIXED (Major depression, PTSD, SCI, Anxiety, amputation)	N=28, Mage = 45, 89% male	The purpose of this study was to examine the effects of a single 45-minute adaptive scuba diving session on veterans' psychological well-being, specifically state-level mindfulness	Primary – quantitative - experimental (pre and post test) - survey	Mental
	Krpalek et al. (2020), USA	MENTAL (PTSD, anxiety, depression, stress)	N=15, Mage 42, 100% male	To explore whether an occupational therapy program in combination with SCUBA diving can enhance occupational performance and mental health outcomes for veterans more than SCUBA diving alone.	Primary - mixed - pre/post experimental-mixed	Mental, home-life
	Abdelkarem (2019), Egypt	PHYSICAL (Paraplegic)	N=10, Mage = 27, 100% male	To assess the psychosocial impact of diving for 10 male divers	Primary – quantitative - pre/post experimental - survey	Physical, mental, social
	Agnovic (2019), Qatar	PHYSICAL (Amputees)	N=12, Mage 33, 100% males	To determine the attainment of the elements of diving techniques, and the effects of programmed instruction of diving on the psychosocial status of war veterans with amputations.	Primary – quantitative - experimental - survey	Mental, social
ROCK / WALL CLIMBING	Delgrande et al. (2019), USA	PHYSICAL (SCI)	N=1, age = 61, male	The purpose of this case report was to document outcomes following a rock climbing program for an individual with an incomplete spinal cord injury (SCI).	Primary - quantitative - longitudinal - survey	Physical, mental
	Bibro & Zarow (2021), Poland	INTELLECTUAL (Mild to moderate intellectual disability. Mostly	N=68, age range = 18-25	The aim of the study was to determine the influence of climbing activities on the	Primary - quantitative experimental (RCT)-other	Physical

	unknown atielogy)		physical fitness of people with ID.		
Steimer & Weissert (2017), Germany	PHYSICAL (Multiple sclerosis)	10 studies - mixed ages and genders	To look at health benefits of rock climbing for people with MS	Secondary - review	Physical, mental, social
Oriel et al. (2018), USA	INTELLECTUAL (Autism spectrum disorder)	N=10, Mage =13, 90% males	The purpose of this pilot study was to: (a) explore the impact of a community-based rock climbing intervention on adolescents with ASD, and (b) examine the social validity of rock climbing as a community-based activity for adolescents with ASD.	Primary -mixed - experimental - other	Mental
Angelini et al. (2020), USA	INTELLECTUAL (ADHD)	N=5, Mage =10, 90% male	Purpose of study was to to explore the effects of rock climbing on attention with children with ADHD	Primary - quantitative - pre/post experimental - survey	Mental
Zielinski et al. (2018), Poland	MENTAL (Depression and / or anxiety)	5 studies - Mixed ages and genders	To assess the influence of sport climbing on depression and anxiety levels	Secondary - review	Mental
Koch et al. (2015), Brazil	PHYSICAL (Cerebral Palsy)	N=8, age range = 4-14, 50% male	The aim of this study was to evaluate the effects of this intervention on handgrip strength, postural control, functional mobility, and the spasticity control of children with cerebral palsy.	Primary - quantitative - case series - survey	Physical
Christensen et al. (2017), Denmark	PHYSICAL (Cerebral Palsy)	N=17, age range = 11-13,	The aim of this study was therefore to test the feasibility of an intensive 3 weeks indoor-climbing training program in children with CP and typically developing (TD) peers.	Primary - quantitative - cross sectional- survey	Physical, social
Biatowas (2018), USA	MIXED (Multiple disabilities)	N=8, age range = 18-21, 66% male	To assess the effects of an indoor rock climbing on highs school aged students with developmental disabilities	Primary -mixed- cross sectional- survey	Mental, social
Velikonja et al. (2010), Slovenia	PHYSICAL (Multiple sclerosis)	N=20, age range = 26-50	Influence of sports climbing and yoga on mood, fatigue and cognitive function in patients with multiple sclerosis	Primary- quantitative - Randomised experimental- survey	Physical

	Stelzer et al. (2018), Germany	MENTAL (MDD)	N=47, Mage = 45, 42% male	To assess if bouldering can reduce symptoms of depression	Primary-quantitative -RCT experimental-survey	Mental
SAILING	Rojhani et al. (2017), USA	PHYSICAL (SCI)	N=1, age =27, male	To demonstrate the mechanisms, adaptability, accessibility, and benefits the sport of sailing creates in the rehabilitative process	Primary-mixed-case study-other	Physical, mental, social, home-life
	Sancassiani et al. (2017), Italy	MENTAL (Severe mental disorders including schizophrenia, affective psychoses, personality disorders)	N=51, Mage = 37, 78% male	This study aimed to assess the efficacy of a psychosocial rehabilitative intervention focused on sailing on quality of life, self-efficacy and sense of coherence in people with severe psychosocial disabilities.	Primary - quantitative - RCT experimental-survey	Mental
	Broadbent & Swalwell. (2018), Australia	PHYSICAL (Multiple Sclerosis)	N=94, Mage = 42, 50% male	Exploring the psychosocial outcomes of a 17 month sailing voyage for people living with multiple sclerosis.	Secondary-qualitative - analysis of data - other	Mental, social, home-life
	Clarke et al. (2020), USA	MIXED (ADHD, Down syndrome, autism, CP, Anxiety)	N=15, age range = 5-18	The current research reviewed the benefits of a sailing program for children with disabilities.	Primary - mixed - cross sectional-survey	Physical, mental, social
	Cappelletti et al. (2020), Italy	PHYSICAL (Epilepsy)	N=58, Mage =15, 48% male	The main aim of our study was to examine the empowerment effects on quality of life of adolescents with epilepsy attending sailing activities, and to compare the results perceived by adolescents and their parents.	Primary – quantitative - cross sectional-survey	Physical, mental
	Carta et al. (2014), Italy	MENTAL (Severe mental disorders (schizophrenia, affective psychoses, personality disorders)	N=40, Mage = 38.5, 95% male	This study set out to evaluate the effectiveness of a sailing and learning-to-sail rehabilitation protocol in a sample of patients diagnosed with severe mental disorders	Primary-quantitative - RCT experimental - survey	Physical
SKIING	Degache et al. (2018), Switzerland	MIXED (Profound intellectual and multiple disability - mainly CP and severe polymalformative syndromes)	N=40, Mage =14, 45% males	The objective of study was to determine the effect of tandem ski activity on postural control and cardiac activity in children with profound intellectual and multiple disabilities	Primary-quantitative -cross sectional descriptive-survey	Physical

	Pasek & Schkade (1995), USA	PHYSICAL (Limb deficiencies)	N=14, age range = 13-19, 50% male	Effects of a 6-day snow skiing trip on 14 adolescents with limb deficiencies were explored. The purpose was to determine whether components of mastery and self-esteem could be identified.	Primary-Qualitative-phenomenological -survey	Mental
	Gimunova et al. (2020), Czech Republic	INTELLECTUAL (Intellectual Disability)	N=47, Mage = 36, 60% male	Purpose of this study was to analyse differences in postural stability between athletes with ID competing in Alpine and Cross country (XC) skiing to assess the effect of special sports training on postural stability in persons with ID	Primary - quantitative - experimental - survey	Physical
	Tangen & Kudlacek (2014), Belgium	PHYSICAL (SCI)	N=4, age range = 55-60, 100% male	To understand the reasons why disabled people partake in extreme skiing	Primary-Qualitative-phenomenological -survey	Social, thrill
ICE SKATING	Fragala-Pinkham et al. (2009), USA	MIXED (Autism, CP, development delay, behavioural disorders)	N=22, age range = 5-12, 45%	To describe an adaptive ice skating programme designed by paediatric therapists.	Primary -mixed-longitudinal - other	Physical, mental, social
	Dursun et al. (2014), Turkey	SENSORY (Visually impaired and hearing impaired)	40 (aged 8-16) 60% girls	In this study, we assessed the effects of ice skating on the psychological well-being, self-concept, and sleep quality of children with hearing or visual impairment.	Primary – quantitative - longitudinal - survey	Mental
	Walsh & Scharf (2013), USA	PHYSICAL (Cerebral Palsy)	N=1, age =5, female	The purpose of this study was to describe the effects of an ice skating program on the ambulation, strength, posture and balance of a child with cerebral palsy (CP).	Primary-quantitative - case report-survey	Physical
KAYAK / SUP	Merrick et al. (2020), Canada	MIXED (wheelchair users, use of crutches)	N=11, Mage = 26, 63% male	The goal of this study was to explore the experiences of kayakers and paddle boarders in two adaptive paddling programs.	Primary-Qualitative-longitudinal - mixed	Physical, mental, social
	Casey et al. (2009), UK	PHYSICAL (SCI)	N=6, age = adults, 50% male	This study aims to gain an insider's perspective on the meaning of engaging in kayaking as a leisure pursuit for six adults with a SCI.	Primary-Qualitative-cross sectional-interview	Physical, mental

	Taylor & mcgruder (1996), USA	PHYSICAL (SCI)	N=3, age range = 23-38, 66% male	The objective of this study was to identify meaningful components of the experience of sea kayaking as described by persons with spinal cord injury (sci).	Primary-Qualitative-cross sectional-interview	Physical, mental, social
	Bjerkefors et al. (2007), Sweden	PHYSICAL (SCI)	N=10, Mage = 38, 70% male	To assess if postural stability of ppl with SCI could be improved with a 10 week kayak training programme	Primary-quantitative - experimental-survey	Physical

Thematic summary

Physical health benefits

General

Overall, 28 studies (49%) presented data on the physical health benefits of participating in the lifestyle sports included in this review (Appendix 1), with seven key outcomes most commonly reported (Table 2). Improvements in body strength and fitness (including cardiorespiratory and overall fitness) were most prevalent, in particular for surfing, rock climbing and kayak/SUP. Handgrip strength (n=4) and overall postural control (n=3) was found to be mainly the domain of rock climbing and sailing. The physical health benefits with the greatest spread across all sports were fitness and balance, occurring in six out of the seven sport types. Surfing had the most reported health benefits (15). Rock climbing was the only study that had at least one reported benefit in each of the seven physical health outcomes. In total physical health benefits were reported 50 times across all studies showing a strong association between physical health and lifestyle sports for disabled people. One study reported no positive change in physical wellbeing (Van Ewijk et al., 2020). A study on scuba diving (Morgan et al., 2018) found some participants suffered from slight abrasions upon entering the water and those with post-traumatic stress disorder (PTSD) sometimes had flashbacks underwater.

Table 2. Total number of physical health outcomes mentioned across all studies

	Surfing	Scuba Diving	Rock Climbing	Sailing	Skiing	Ice Skating	Kayak/SUP	Total
Strength (Body)	4	1	3			2	3	13
Fitness (Overall)	3	2	3	1	1		1	11
Flexibility	2	1	1					4
Endurance/Stamina	4		1			2	1	8
Balance	2		1		1	1	2	7
Grip Strength			3	1				4
Postural Control			1		1	1		3
Total	15	4	13	2	3	6	7	50

Clinical

All seven sports types showed physical benefits that were of clinical importance to disabled people. Most prominent was how the changes in physical health brought about by participation in these sports helped with activities of daily living (ADL). They ranged from reduction in use of crutches (Schmid et al., 2019), enhanced ability to walk more independently (DelGrande et al., 2019) or use prosthetics (Fleischmann et al., 2011). Others reported an increased ability to transfer from floor to stand (Walsh & Scharf, 2013) or from chair to bed (Casey et al., 2009). Aspects of life were also enhanced such as being able to hold a glass (Koch et al., 2015) or open a door (Christensen et al., 2017). These ADL were reported to be done with less tiredness and fatigue (Velikonja et al., 2010; Steimer & Weissert, 2017). Better control of the body was reported across four studies (Bjerkefors et al., 2007; Rojhani et al., 2017; Degache et al., 2018; Gimunová et al., 2020).

There was a reduction in pain found from participating in lifestyle sports in five studies across four of the five disability groups (Fleischmann et al., 2011; Britton et al., 2020; Krpalek et al., 2020; Naumann et al., 2021; Henrykowska et al., 2021). This was particularly the case with amputees when scuba diving due to the weightlessness of the sport.

Mental health benefits

General

The mental health benefits of lifestyle sports for disabled people were a particularly prominent theme with 43 studies (75%) (Appendix 1) reporting benefits across 11 different mental health outcomes. The evidence suggests that improved confidence is a key mental health outcome of participating in lifestyle sports for disabled people (Table 3). Multiple studies highlighted the opportunity to master a new skill as being a facilitator of participants' confidence that was translated into a new 'can do it' mindset (Pasek & Schkade, 1996; Taylor & McGruder, 1996; Casey et al., 2009; Schmid et al., 2019). This confidence, self-esteem, self-efficacy and self-worth was a common by-product of almost every sport. Water sports offered the greatest accumulation of reported mental health benefits (58 of a total 74), with scuba diving in particular scoring on 10 out of the 11 reported mental health outcomes. This manifests into a general improvement in psychological wellbeing (happiness, mood, quality of life, positivity and mindfulness) that was another common outcome across this mental health theme. One ice-skating study (Dursun et al., 2014), focusing on people with sensory impairment, found that self-concept improved for the hearing impaired but decreased for the visually impaired.

Table 3. Total number of mental health outcomes mentioned across all studies

	Surfing	Scuba Diving	Rock Climbing	Sailing	Skiing	Ice Skating	Kayak/ SUP	Total
Confidence	8		4	2	1	1	1	17
Anxiety (Decreased)	5	2	1					8
Stress (Decreased)	1	1						2
Self Esteem	5	2	1		1	1	1	11
Depression (Decreased)	4	2	1					7
Psychological Wellbeing	2	4	3	3				12
Self Efficacy	2		1					3
Self Concept		1						1
Sense of Freedom	2						2	4
PTSD (Decreased)	5	1						6
Focus		1		1				2
Total	32	16	11	6	2	2	4	74

Clinical

Alongside the general mental health benefits, there were strong clinical mental health benefits found in participating in lifestyle sports. A reduction in symptoms of depression, anxiety, stress and PTSD were reported across a range of studies (Glassman et al., 2021; Rogers et al. 2014; Caddick et al., 2015; Crawford, 2016; Caddick & Smith, 2017; Morgan et al., 2018; Zieliński et al., 2018; Stelzer et al., 2018; Walter et al., 2019; Krpalek et al., 2020; Otis et al., 2020). This was mainly when the study was focusing on these mental disorders, but does display the power that these sports have on a clinical level. People with autism were also found to have an improvement in ability to learn and interact with new people (Moore et al., 2017; Van Ewijk et al., 2020).

Impact on family / caregivers

The benefits gained from lifestyle sports for disabled people also impacted family and caregivers. This scoping review found an overall improvement in family life (Schmid et al., 2019) ranging from better communication with family (Moore et al., 2017; Clapham et al., 2020) to increased participation in home activities like cooking (Broadbent and Swalwell, 2019) to improved behaviour and less aggression

shown to loves ones (Moore et al., 2017; Devine-Wright & Godfrey, 2020). In some cases, marriages and relationships were deemed to have been saved as a result of scuba diving (Morgan et al., 2018; Krpalek et al., 2020). Devine-Wright & Godfrey (2020) in an evaluation spanning five years (2013-2017) of 'The Wave Project', a UK wide surf therapy programme for young people, found that surfing acted as an experience that all the family could share thus creating a stronger family bond. Four studies across sailing, surfing and scuba diving, reported participants being happier people at home with better mood (Rojhani et al., 2017; Morgan et al., 2018; Britton et al., 2020; Van der Merwe & Yarrow, 2020).

Emergent themes

Social

A strong theme that emerged through this research process was the social and community aspect that was developed through participating in lifestyle sports. In total 30 out of the 57 studies (52%) reported these benefits (Appendix 1). These sports allowed disabled people to make friends, build social networks and interact with other people. A sense of belonging and community encouraged participants to talk openly about their disabilities and in some cases to improve their social skills in a safe environment. This safe social environment was created through the groups' successful interaction with the challenging aspects and dangers inherent in lifestyle sports. Surfing, rock climbing, scuba diving and sailing harnessed thenecessity of safety in the sport such as, to 'buddy up' and work as a team, to form strong social interactions (Van der Merwe & Yarrow, 2020; Abdelkarem, 2019; Steimer & Weissert, 2017; Broadbent & Swalwell, 2019). While skiing, ice skating and kayaking encouraged joviality and camaraderie amongst participants through chatting during the sport (Tangen & Kudlacek, 2014; Fragala-Pinkham et al., 2009; Merrick et al., 2020). Carin-Levy & Jones, 2007, during a scuba diving intervention, found participants perceptions of social support (family, friends, community) improved to a level of statistical significance ($p \leq 0.01$). This was echoed across the studies but summed up in particular by Moore et al. (2017) who found that surfing works where team sports don't in being inclusive without being forceful, welcoming people into a 'surf community'.

Thrill of sport / the environment

Synonymous with the health benefits garnered from lifestyle sports was the thrill and adrenaline of participation (Crawford, 2016; Yarwasky & Furst, 1996; Oriel et al., 2018; Tangen & Kudlacek, 2014). These thrills manifested in numerous ways, offering disabled people a reason to engage in physical activity (Christensen et al., 2017), develop coping strategies to deal with their disabilities (Rojhani et al., 2017) and to help reconstruct identity after life changing experiences (Tangen & Kudlacek, 2014). Carta et al. (2014) found that the unpredictable and lively environment of sailing at sea could act as a substitute of important joyful or thrilling experiences that people with severe mental disorders miss because of their illness.

Effect on society

Participation in lifestyle sports was found to not only impact the disabled person and their family and caregivers, but also wider society. Engaging in a sport such as kayaking, which is often seen as the realm of the non-disabled, helped to challenge the perceptions of onlookers (Merrick et al., 2020). By enabling disabled people to participate in public places it helped to raise awareness of disability and promoted a sense of equality amongst participants (Casey et al., 2009).

DISCUSSION

To our knowledge, this scoping review is the first of its kind to document the physical and mental health benefits of lifestyle sports for disabled people. A total of 57 studies were found, across seven different sports, highlighting these benefits alongside emergent themes such as the development of social skills and building of community that lifestyle sports afforded people (Appendix 1).

Our results are consistent with previous literature showing the benefits gained by disabled people from participation in other non-lifestyle sports. A recent systematic review by Martin Ginis et al. (2021), covering 36 meta-analysis studies, found there were significant physical health benefits of any type of PA for disabled people, but with mixed mental health benefits. Another systematic review (Aitchison et al., 2021), on the perceived health benefits of sports for disabled people overlooked all but one lifestyle sport

– scuba diving (Carin-Levy & Jones, 2007). They reported few physical benefits but with distinct mental health and social improvements. This scoping review goes beyond these most current findings by highlighting the ability of lifestyle sports to positively affect all three health outcomes for disabled people.

Our review also showed that the physical and mental health benefits of lifestyle sports had far reaching clinical benefit. Participants reported increased capability of walking independently (DelGrande et al., 2019; Schmid et al., 2019), transferring from wheelchair to bed (Casey et al., 2009; Walsh & Scharf, 2013) and in some cases a reduction in general pain (Fleischmann et al., 2011; Britton et al., 2020; Krpalek et al., 2020; Naumann et al., 2021; Henrykowska et al., 2021). Lifestyle sports have been successful in treating the symptoms of depression, anxiety, stress and PTSD whilst giving confidence to disabled people through mastering a new skill (Glassman et al., 2021; Rogers et al. 2014; Caddick et al., 2015; Crawford, 2016; Caddick & Smith, 2017; Morgan et al., 2018; Zieliński et al., 2018; Stelzer et al., 2018; Walter et al., 2019; Krpalek et al., 2020; Otis et al., 2020). However, these benefits were not always long lasting and in a few instances depression and PTSD returned to baseline levels after completion of the intervention, highlighting the need for ongoing support (Moore et al., 2017; Carta et al., 2014, Morgan et al., 2018).

This review found additional strength in the findings through the testament of the disabled persons family or caregivers. People were described as happier (Rojhani et al., 2017; Morgan et al., 2018; Britton et al., 2020; Van der Merwe & Yarrow, 2020), family life was improved (Schmid et al., 2019; Moore et al., 2017; Clapham et al., 2020) and in some instances marriages were even saved as a consequence of participation in lifestyle sports (Morgan et al., 2018; Krpalek et al., 2020). Although this scoping review does not seek to address the benefits to family and caregivers, there may be a duality to any benefits between the disabled person and family/caregiver. For children, or those with disabilities that require constant care, it could prove life changing to have an effect from sport that can also enhance the life of the family/caregiver given it is they who have the power to influence this person's life, either positively or negatively. In promoting a sense of family inclusion in sport and excitement from the benefits, there is a chance for these lifestyle sports to have a lasting impact.

We acknowledge that there was a circular nature to many of the themes found within this scoping review. Not only can the perceptions of the disabled person, their family or caregivers be changed through participation in lifestyle sports, but also society's (Casey et al., 2009; Merrick et al., 2020). Similarly, other research has shown how sports can help manage stigma and challenge public perceptions of disability (Lindemann & Cherney, 2008; Lundberg et al., 2011). The societal impact of seeing disabled people participating in extreme, outdoor, adventure or active sports, although under researched, has the potential to greatly improve the provision of adaptive sports, their equipment and the opportunity to participate. However, this should not be at the expense of the disabled person. The concept of ableism is perpetuated by the media who help to shape society's attitudes toward disability by creating a socially acceptable notion of health that can act as a barrier to participation in sport for some disabled people (Rees et al., 2017). However, they also have the power to change attitudes. Images of disabled people competing at elite sports can help to challenge outdated preconceptions of what being disabled means. On the other hand, this media portrayal can also marginalise disabled people. The non-disabled world is full of stories that emphasis disabled sportspersons as the 'supercrip' (Clare, 2009). This label focuses on disabled people 'overcoming' their disabilities and celebrates normal people as heroes merely for participating in sports (Hardin & Hardin 2004). It turns disabled people into symbols of inspiration, instead of focusing on them as individuals who face societal struggles with their disability.

Through interacting with the more extreme and outdoor nature of these sports, disabled people found a commonality and safe space to express themselves (Van der Merwe & Yarrow, 2020; Abdelkarem, 2019; Steimer & Weissert, 2017; Broadbent & Swalwell, 2019; Tangen & Kudlacek, 2014; Fragala-Pinkham et al., 2009; Merrick et al., 2020). This is in agreement with studies on non-disabled youth that highlighted the importance of skateparks and mountain bike trails as spaces where young, like-minded people can congregate and build friendships (King, 2010; Taylor & Khan, 2011). For disabled people these

shared experiences and opportunities to mix brought with them friendship and in some cases a safe domain to share some of their mental health issues. This therapeutic element of the lifestyle sports experience was found to positively impact people with PTSD, depression or anxiety (Rogers et al., 2014; Crawford, 2016; Caddick et al., 2015; Caddick & Smith, 2017; Stelzer et al., 2018; Zieliński et al., 2018; Walter et al., 2019; Otis et al., 2020; Blumhorst et al., 2020; Krpalek et al., 2020), whilst the group based social element proved valuable to those people on the autism spectrum in particular (Stuhl & Porter, 2015; Oriel et al., 2018; Van der Merwe & Yarrow, 2020; Britton et al., 2020).

Taking part in lifestyle sports may provide a place to fit in and express oneself without scrutiny or judgement. Our review finds a more complex answer. Whilst the thrill and adrenaline of these alternative sports was an attraction (Carta et al., 2014; Crawford, 2016; Oriel et al., 2018; Tangen & Kudlacek, 2014; Yarwasky & Furst, 1996), offering difference to traditional sports, there was no evidence to suggest it was anti-establishment. Disabled people took part in lifestyle sports that now have formal associations. They were able to participate with non-disabled people and subsequently improve their life and the views of others in mainstream society.

Studies relating to just seven lifestyle sports, focusing on the benefits for disabled people, were found in this review. This may owe to the relatively recent emergence of these sports in a healthcare context as one third of all included studies were published in the last two years (2020-2021). Surfing provided the greatest amount of research on benefits to disabled people (19/57 studies) which is in accordance with a scoping review of the evidence base for surf therapy (Benninger et al., 2020). This review builds on that evidence, finding an additional seven studies since then (Clapham et al., 2020; Britton et al., 2020; Van Ewijk et al., 2020; Devine-Wright & Godfrey, 2020; Otis et al., 2020; Van der Merwe & Yarrow, 2020; Glassman et al., 2021) whilst also highlighting two studies that were missed within Benninger et al.'s search dates (2008-2019) (Stuhl & Porter, 2015; Schmid et al., 2019). A recent study by Marshall et al. (2020) found that surfing is an adaptable vehicle for promoting wellbeing and social skills in a post-conflict setting. The sport is now being socially prescribed in the UK (The Wave Project, 2021) to treat depression, anxiety and stress in young people and it is apparent that this nascent area has the potential to reach a wide array of disabled people and provide a benchmark for other lifestyle sports to become socially prescribed.

Study limitations and recommendations

Our review found that the majority of studies had methodological limitations such as small sample sizes, no uniform length of study for each sport type, a poorly represented population, a lack of comparison groups and not enough RCTs. Until these limitations are addressed, it will be hard to state with any certainty whether these positive results are true effect, or simply an artefact of the small and underpowered studies.

There was a wide variety of outcomes across the studies with no consensus or consistency in the gradation of levels of severity of disability, or how to measure the effects of these sports for disabled people. This may stem from difficulty in collecting data from those disabled people who are unable to fully express their feelings, pointing toward a need for a more standardised measure. Researchers need to adopt more creative means of collecting data such as the use of pictograms and other creative arts-based ways of analysing effect. Progress is being made and a recent study by Britton et al. (2020) used body mapping, a novel participatory evaluation method, to analyse effect from a surfing intervention for young people with autism.

Our review critically appraised the studies for quality and generalisability and found an overall moderate to low scoring for both areas across the majority of studies. At present there is a lack of quality evidence because there are not enough RCTs. With very few RCTs, confounding factors such as the skill level of the coach/facilitator, the equipment used, variability in participants medication, and their mood or even their energy levels at different times of the day may also impact results. The scarcity of RCTs may be because there are currently too many outcomes parameters and measures used. To break this circle there needs to be greater consultation with disabled people to understand the real-life outcomes that are required from lifestyle sports studies. Research should be conducted with disabled people and not on them, using an integrated knowledge translation approach to ensure findings are relevant, useful and useable (Jull et al., 2017).

There is no one-size-fits-all approach and thus involving disabled people, researchers, policy makers, parents/caregivers and health-care workers will help to provide a more unified body of evidence.

Research gaps and areas for future research

Future research is needed that consults with disabled people, researchers, policy makers, parents/caregivers and health-care workers to develop more specific outcomes using established measures to evaluate these outcomes across all lifestyle sports. This would enable a more rigorous assessment of lifestyle sports' impact. Gaining a better understanding of the appropriate duration, intensity and quantity needed for long-term improvements would also enable a better understanding of its effectiveness. Alongside this, future studies should look at whether it is the sport, being in nature, or participating as part of a group that creates these benefits.

Overall, more studies of the kind found in this review are needed to help drive policy and bring the level of evidence in line with non-disabled research on lifestyle sports. Relatively few studies on health for disabled people are accepted by medical journals despite disabled people's growing numbers and healthcare costs (Iezzoni, 2013). It is hoped that by encouraging more research into the exciting field of lifestyle sports and disability it will help to develop the overall quality of studies, forcing journals to accept more submissions and ultimately facilitating change on a societal level through increased readership.

Conclusion

The findings from this review highlight the physical and mental health benefits of lifestyle sports for disabled people at both a general and clinical level. However, results must be framed against the overall moderate to low level quality of evidence. Our scoping review was the first of its kind to piece together the information from this burgeoning field of research and, importantly, we hope the findings can challenge researchers and practitioners to do more, whilst simultaneously influencing disabled people's sport and PA choices and ultimately impact future policy.

Conflict of interest

No conflict of interest is declared by the authors. In addition, no financial support was received.

Author Contributions

Study Design: LY, CF, JL; Data Collection: LY, CF; Statistical Analysis: LY; Data Interpretation: LY, JL; Manuscript Preparation: LY, CF, JL; Final review and editing: LY and CF; Literature Search, LY, JL. All authors have read and agreed to the published version of the manuscript.

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Addition:

Appendix 1. Summary of study characteristics, quality and generalisability and improved outcomes for health benefits

	Author (Year), Country	Disability category	Improved outcomes	Quality	Generalisability
			Physical benefits		
SURFING	Clapham et al. (2020), USA	INTELLECTUAL	Core strength, upper body strength, cardio respiratory fitness, flexibility and endurance.	Moderate	High
	Schmid et al. (2019), USA	MIXED	Improved strength, endurance, and flexibility.	Moderate	Low
	Moore et al. (2017), USA	INTELLECTUAL	Increased balance, muscle tone, stamina	Moderate	Moderate
	Fleischman et al. (2011), USA	PHYSICAL	Improved balance	Low	Low
	Benninger et al. (2020), USA	MIXED	Improvements in physical fitness,	Moderate	N/A
	Armitano et al. (2015), USA	INTELLECTUAL	Overall improvement in upper body strength, core strength and cardiorespiratory endurance	Moderate	Low
	Stuhl & Porter (2015), USA	INTELLECTUAL	General improvement in physical health	Moderate	N/A
SCUBA DIVING	Henrykowska et al. (2021), Poland	MIXED	Mixed results on physical fitness, but improvements in motor skills, respiratory fitness,	Moderate	High
	Naumann et al. (2021), Australia	MIXED	Improved fitness and strength, increased heart rate, rating of perceived exertion and affect, stretching,	Moderate	Low
	Abdelkarem (2019), Egypt	PHYSICAL	Flexibility, increased movement and improved sensation from being in the water	Moderate	Low
ROCK / WALL CLIMBING	DelGrande et al. (2019), USA	PHYSICAL	Increased muscle strength and arm girth.	Moderate	Low
	Bibro & Zarow (2021), Poland	INTELLECTUAL	Significantly improved balance, upper body strength and handgrip force. All physical fitness improved.	Moderate	Moderate
	Steimer & Weissert (2017), Germany	PHYSICAL	Cardiorespiratory fitness and muscular endurance.	Moderate	N/A
	Koch et al. (2015), Brazil	PHYSICAL	Improvements in the handgrip strength, postural control, functional mobility, and spasticity control of these children.	Low	Low
	Christensen et al. (2017), Denmark	PHYSICAL	Improvements in the sit to stand tests, improvement in pinch grip strength. Physical fitness and strength can be improved with people with CP after a 3 week climbing intervention.	Low	Low
	Velikonja et al. (2010), Slovenia	PHYSICAL	Improved flexibility	High	Moderate
SAILING	Rojhani et al. (2017), USA	PHYSICAL	Sailing improved his mobility	Low	Low
	Clarke et al. (2020), USA	MIXED	Significant increase in grip strength	Low	Low

	Cappelletti et al. (2020), Italy	PHYSICAL	Improvement in general physical health	Low	Moderate
	Carta et al. (2014), Italy	MENTAL	Statistically significant improvement of their clinical status and of their general functioning.	High	Moderate
SKIING	Degache et al. (2018), Switzerland	MIXED	Better rest and recovery heart rate after skiing.	Low	Moderate
	Gimunova et al. (2020), Czech Republic	INTELLECTUAL	Better postural stability, enhanced balance skills	Moderate	Moderate
ICE SKATING	Fragala-Pinkham et al. (2009), USA	MIXED	Leg strength, endurance, balance	Moderate	Low
	Walsh & Scharf (2013), USA	PHYSICAL	Improvements in standing posture, increased strength	Low	Low
KAYAK / SUP	Merrick et al. (2020), Canada	MIXED	Improvements in core strength and fitness	Moderate	Low
	Casey et al. (2009), UK	PHYSICAL	Upper body strength, fitness and balance	Moderate	Low
	Taylor & McGruder (1996), USA	PHYSICAL	Increased strength and stamina, improved balance	Moderate	Low
	Bjerkefors et al. (2007), Sweden	PHYSICAL	Improved upper body stability	Moderate	Low
	Mental benefits				
SURFING	Clapham et al. (2020), USA	INTELLECTUAL	Improved self confidence, and decreased anxiety.	Moderate	High
	Schmid et al. (2019), USA	MIXED	Decline in social anxiety and stress. Increase in self-confidence and independence.	Moderate	Low
	Moore et al. (2017), USA	INTELLECTUAL	Improvement in self esteem and self confidence.	Moderate	Moderate
	Caddick and Smith. (2017), UK	MENTAL DISORDER	Respite from PTSD	Low	Low
	Glassman et al. (2021), USA	MIXED	Significant increases in positive affect and decreases in symptoms of depression/anxiety.	Moderate	High
	Ewijk et al. (2020), Netherlands	INTELLECTUAL	Significant improvement was seen in overall quality of life as well as three specific domains: Psychological well-being, growth in self-esteem, self-confidence and autonomy.	Moderate	High
	Devine-Wright & Godfrey (2020), UK	MIXED	Improvement in overall wellbeing, self esteem. Positive emotions, coping and self strategy, confidence and motivation,	Moderate	High
	Rogers et al. (2014), USA	MENTAL DISORDER	Participants reports of PTSD significantly lower after 5 week intervention. A renewed sense of self - efficacy in a non combat arena.	Low	Low
	Crawford (2016), USA	MENTAL DISORDER	Improvements in self efficacy, reductions in depression and lessening of symptoms of PTSD	Moderate	Low
	Walter et al. (2019), USA	MENTAL DISORDER	Significant decrease in depression, anxiety, PTSD and negative affect while positive	Moderate	High

			affect significantly increased.		
	Otis et al. (2020), USA	MENTAL DISORDER	Improvements in depression/anxiety and positive effect following surf therapy	Low	Moderate
	Lopes et al. (2018), Portugal	MIXED	Autonomy, self esteem	Low	Low
	Benninger et al. (2020), USA	MIXED	Self confidence	Moderate	N/A
	Van de Merwe & Yarrow. (2020), S.Africa	INTELLECTUAL	Confidence and self esteem	Low	Moderate
	Stuhl & Porter (2015), USA	INTELLECTUAL	Self esteem	Moderate	N/A
	Britton et al. (2020), Ireland	INTELLECTUAL	Confidence and self esteem	Moderate	Low
SCUBA DIVING	Henrykowska et al. (2021), Poland	MIXED	Positive mental health impact (78% of participants), massive impact on self esteem, improvement in self belief,	Moderate	High
	Morgan et al. (2018), UK	MIXED	Improvement in levels of anxiety, depression. Being underwater offered them a sense of freedom from their physical impairments	Low	Low
	Carin-Levy & Jones, (2007), UK	PHYSICAL	Improved self concept.	Moderate	Low
	Stefania et al. (2019), Italy	MIXED	Improved cognitive ability after scuba diving	Moderate	Low
	Naumann et al. (2021), Australia	MIXED	Sense of freedom and relaxation	Moderate	Low
	Blumhorst et al. (2020), USA	MIXED	Post scuba increased mindfulness as diving allowed them to focus on only one thing. Contentment massively increased post dive.	Moderate	Low
	Krpalek et al. (2020), USA	MENTAL	Improvements in PTSD, depression, anxiety and stress scores. Participants reported increased self-awareness, increased regulation, decreased anxiety, and improved mood. improved concentration, increased focus, decreased stress, and decreased anxiety	Moderate	Low
	Abdelkarem (2019), Egypt	PHYSICAL	Improved QoL after 3 week training. Significant positive differences in the happiness score post test.	Moderate	Low
	Agnovic (2019), Qatar	PHYSICAL	Improved self esteem	Moderate	Low
ROCK / WALL CLIMBING	DelGrande et al. (2019), USA	PHYSICAL	Improvement in the overall being	Moderate	Low
	Steimer & Weissert (2017), Germany	PHYSICAL	Feelings of success, increase self-confidence and self-esteem	Moderate	N/A
	Oriel et al. (2018), USA	INTELLECTUAL	Confidence and focus	Moderate	Low
	Angelini et al. (2020), USA	INTELLECTUAL	Improvements in confidence, problem solving and perseverance.	Moderate	Low

	Zielinski et al. (2018), Poland	MENTAL	Practicing climbing can benefit depression treatment by controlling the feeling of fear and anxiety, which may also occur during depression	Moderate	Low
	Biatowas (2018), USA	MIXED	Improved mental well-being , confidence	Low	Low
	Stelzer et al. (2018), Germany	MENTAL	Improved mood	High	Moderate
SAILING	Rojhani et al. (2017), USA	PHYSICAL	The participant noted improvements in mood, self-worth. Sea had a calming effect.	Low	Low
	Sancassiani et al. (2017), Italy	MENTAL	Self-efficacy significantly increased after the sailing course and decreased after treatment	High	Moderate
	Broadbent & Swalwell. (2018), Australia	PHYSICAL	Feeling stronger and more confident	Moderate	High
	Clarke et al. (2020), USA	MIXED	Increase in self confidence, increase on positive outlook on life.	Low	Low
	Cappelletti et al. (2020), Italy	PHYSICAL	Improvement in emotional functioning	Low	Moderate
SKIING	Pasek & Schkade (1995), USA	PHYSICAL	Positive self-evaluation, self-esteem, confidence.	Moderate	Low
ICE SKATING	Fragala-Pinkham et al. (2009), USA	MIXED	Self esteem/confidence	Moderate	Low
	Dursun et al. (2014), Turkey	SENSORY	Self-concept, behavioural and emotional problems	Moderate	Moderate
KAYAK / SUP	Merrick et al. (2020), Canada	MIXED	Sense of freedom and equalising effect of being on the water.	Moderate	Low
	Casey et al. (2009), UK	PHYSICAL	Sense of freedom, sense of achievement, kayaking generated optimism about the future.	Moderate	Low
	Taylor & McGruder (1996), USA	PHYSICAL	Improvement in self-esteem and confidence from trying something new."I can do this" sense of achievement from kayaking.	Moderate	Low
			Social benefits		
SURFING	Clapham et al. (2020), USA	INTELLECTUAL	Gains in social development	Moderate	High
	Schmid et al. (2019), USA	MIXED	The surfing helped participants with their families, friends, and among the community (social outcomes).	Moderate	Low
	Caddick et al. (2015), UK	MENTAL DISORDER	The social aspect of surfing helped encourage banter and talk about their problems.	Moderate	Low
	Moore et al. (2017), USA	INTELLECTUAL	This social and inclusive environment of the 'surf community' seems to generate interactions with others, which parents suggest improve children's social skills and feelings of inclusion.	Moderate	Moderate

	Caddick and Smith. (2017), UK	MENTAL DISORDER	Social bonds formed through surfing	Low	Low
	Glassman et al. (2021), USA	MIXED	Women responded well to the positive group norms formed through surf therapy.	Moderate	High
	Ewijk et al. (2020), Netherlands	INTELLECTUAL	Socio-emotional impact of surfing intervention. Children were part of a team whilst still surfing individually and were rewarded / given prizes at end of each session.	Moderate	High
	Devine-Wright & Godfrey (2020), UK	MIXED	Social trust - making friends when usually wouldn't do. Improved social skills.	Moderate	High
	Crawford (2016), USA	MENTAL DISORDER	Social connections made through surfing important.	Moderate	Low
	Lopes et al. (2018), Portugal	MIXED	Social relationships improved	Low	Low
	Benninger et al. (2020), USA	MIXED	Social development	Moderate	N/A
	Van de Merwe & Yarrow. (2020), S.Africa	INTELLECTUAL	Helped to build friendships	Low	Moderate
	Stuhl & Porter (2015), USA	INTELLECTUAL	Significant improvement in social skills	Moderate	N/A
	Britton et al. (2020), Ireland	INTELLECTUAL	Built rapport with others	Moderate	Low
SCUBA DIVING	Henrykowska et al. (2021), Poland	MIXED	Diving improved scope and quality of social interactions	Moderate	High
	Morgan et al. (2018), UK	MIXED	Social interaction ("bonding") with like-minded individuals	Low	Low
	Carin-Levy & Jones, (2007), UK	PHYSICAL	Enhancement of social experiences. 'Buddy' system etc allowed them to engage with others.	Moderate	Low
	Naumann et al. (2021), Australia	MIXED	Socially supportive aspect of SCUBA	Moderate	Low
	Abdelkarem (2019), Egypt	PHYSICAL	Sense of community found with a led bodied people with the 'buddy' system used in diving.	Moderate	Low
	Agnovic (2019), Qatar	PHYSICAL	Perceived social support significantly rose after the scuba diving intervention	Moderate	Low
ROCK / WALL CLIMBING	Steimer & Weissert (2017), Germany	PHYSICAL	Improved ability for social interaction	Moderate	N/A
	Christensen et al. (2017), Denmark	PHYSICAL	Mental and social skills improved	Low	Low
	Biatowas (2018), USA	MIXED	Social emotional benefits	Low	Low
SAILING	Rojhani et al. (2017), USA	PHYSICAL	Sense of community belonging	Low	Low
	Broadbent & Swalwell. (2018),	PHYSICAL	Teamwork and camaraderie	Moderate	High

	Australia				
	Clarke et al. (2020), USA	MIXED	Social skills	Low	Low
SKIING	Tangen & Kudlacek (2014), Belgium	PHYSICAL	Strong social benefits	Moderate	Low
ICE SKATING	Fragala-Pinkham et al. (2009), USA	MIXED	Ability to participate in a group after participating in the ice skating programme.	Moderate	Low
KAYAK / SUP	Merrick et al. (2020), Canada	MIXED	Prominent social component to paddling as most paddlers chatted jovially throughout their session	Moderate	Low
	Taylor & McGruder (1996), USA	PHYSICAL	Kayaking helped socialising with emphasis shifted from disability to the sport.	Moderate	Low